Development of an algal wastewater treatment concept, based on the selection of microalgal strains with optimal bioextraction characteristics

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What is E4Water?

E4WATER
Economically and Ecologically Efficient Water Management in the European Chemical Industry

- E4Water addresses crucial process industry needs, to overcome bottle necks and barriers for an integrated and energy efficient water management.
- The main objective of E4Water is to develop, test and validate new integrated approaches, methodologies and process technologies for a more efficient and sustainable management of water in chemical industry with cross-fertilization possibilities to other industrial sectors.
- E4water unites in its consortium large chemical industries, leading European water sector companies and innovative RTD centers and universities, active in the area of water management and also involved in WssTP and SusChem and collaborating with water authorities.

Aims

- creating water loop interfaces, synergies and symbiosis: (a) in industry (b) with urban & agricultural water management
- developing and testing innovative materials, process technologies, tools and methodologies for an integrated water management (e.g. closure of industrial water loops; reuse/recycling of wastewater)
- providing an open innovation approach for testing E4Water developments with respect to other industries
- implementing and validating the developments in 6 industrial case studies, representing critical problems for the chemical industry and other process industries, implementing improved tools for process efficiency optimization, linking water processes with production processes, and ecoefficiency assessment.
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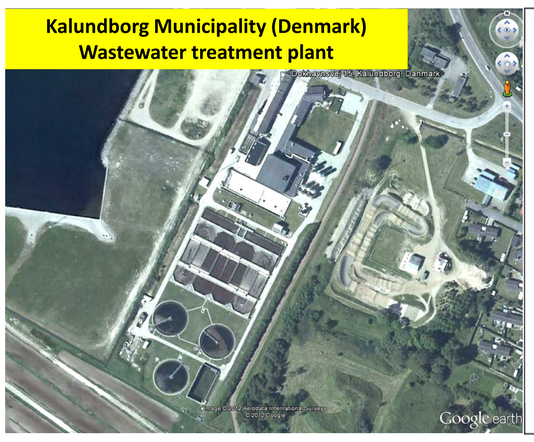
Microalgal Treatment

In the frame of E4Water, the Technical University of Denmark (Department of Environmental Engineering) and the Cluster Biofuel Denmark of Kalundborg municipality (CBD) propose an innovative industrial wastewater treatment concept, based on use of microalgal strains for removal of nutrients and carbon from wastewater. The algal biomass produced will be used in a biorefinery concept for production of biochemicals and biofuels. Two different approaches will be tested:

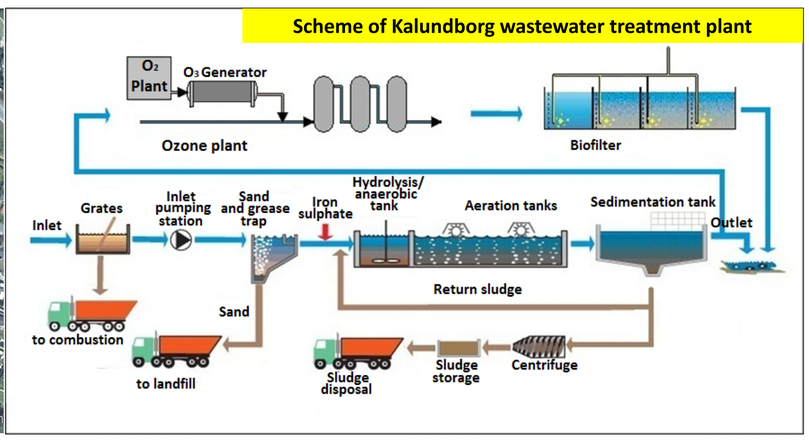
- **Use of hetero/mixotrophic algal growth for carbon and nutrients removal from wastewaters.**
- **Use of autotrophic algal growth for nutrients removal from bacterial treated wastewaters.**

In both cases the produced microalgal biomass will be harvested and used for production of high value added products and biofuels.
Microalgal species will be screened against a number of selected wastewaters from the local Industry in Kalundborg via an innovative method based on microplates and a Synergy Microplate Reader. The selected algal species/wastewaters combinations, together with the assessed culturing/harvesting/extraction technologies, will be used for the development of a continuous photobioreactor at the upscaled test facility site situated inside the Kalundborg municipal wastewater treatment plant perimeter.

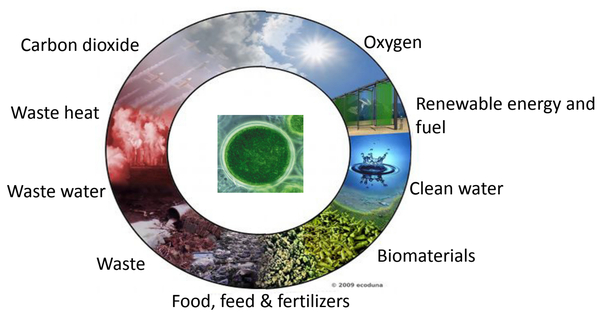
Kalundborg Municipality (Denmark)
Wastewater treatment plant



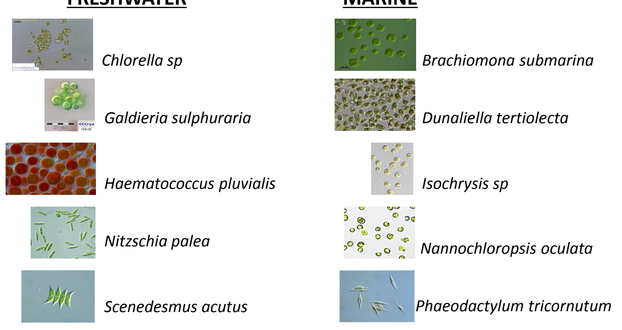
Scheme of Kalundborg wastewater treatment plant



Waste to Value – a residue becomes a resource

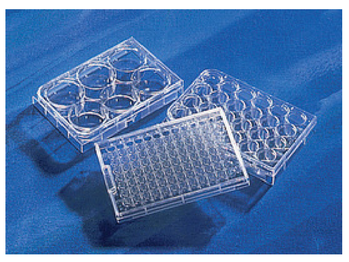


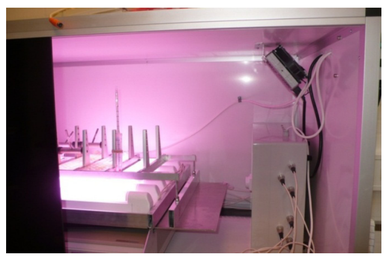
Candidate algal species

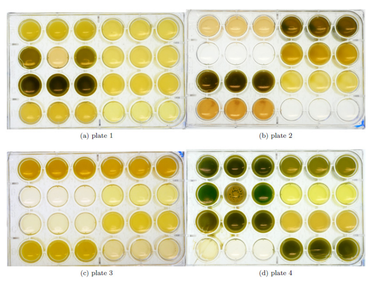


Strategy: Step 1 - Microplate Screening

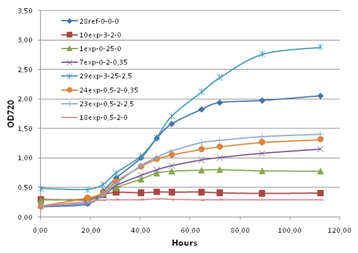
- A number of **industrial wastewaters** (Novozymes, Inbicon and others) will be chosen as appropriate for algal treatment based on available chemical characteristics
- A variety of **microalgal species** will be screened for their potential to grow in wastewaters
- The selection will be made based on:
  - biomass production
  - production of target compounds
  - separability of biomass
  - nutrients (N,P) and COD uptake capacity
  - biogas potential of the biomass







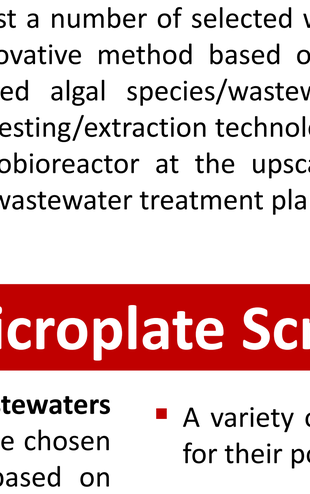
Microplate Reader

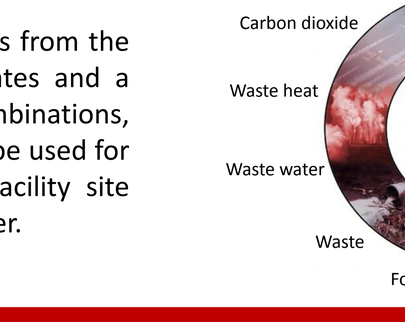


Best algal species for each wastewater

Step 2 - Upscale

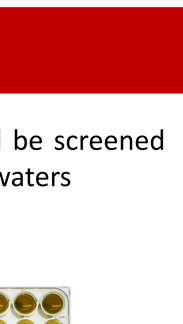
The selected species/wastewater combinations will undergo lab-scale tests to evaluate the optimal solution for the pilot scale test site





Flat panel
Lab scale photo-bioreactor

Pond-like
Lab scale
photobioreactor



Comparison of potential yields vs. costs

Cultivation system choice